

2002 Paper 1 Question 6

Foundations of Computer Science

- (a) Explain how O -notation is used to express efficiency of algorithms. [5 marks]
- (b) Arrange the following list of complexity classes in order of decreasing efficiency in n . Briefly justify each relationship.

$$O(5n^2) \quad O(e^n) \quad O(n^{1/3}) \quad O(n^3 - 3n^2) \quad O(\log n) \quad O(n2^n)$$

[4 marks]

- (c) Suppose that f is a function from integers to integers such that $i \leq j$ implies $f(i) \leq f(j)$. Then there is an efficient algorithm to solve the equation $f(k) = y$, given the desired y and a range of values in which to search for k : the idea is repeatedly to halve this range. Code this algorithm as the ML function `search` whose arguments are f , y , and the range (a, b) . Its result should be the greatest k such that $f(k) \leq y$ and $a \leq k \leq b$, provided such a k exists.

[11 marks]